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Original research article

Assessment of thrombocytopenia with particular reference to platelet indices

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Abstract

Background: A platelet count of less than 150 000/L indicates thrombocytopenia, which can be caused by a wide variety of haematological and pathological diseases. Possible causes include insufficient production, excessive destruction, an irregular distribution of platelets, and dilutional loss.

Methods: From June 2021 to May 2022 researchers at a Department of Pathology, Maheswara Medical College and Hospital, Sangareddy, analyzed data gathered from prospectively placed cameras. Patients with thrombocytopenia were classified as either hyperdestructive or hypoproductive.

Results: 50 patients were included in the analysis, with eleven having hyperdestructive thrombocytopenia and the remaining thirty-nine having hypoproductive thrombocytopenia. The former category consisted entirely of cases of immune-mediated thrombocytopenia, which accounted for 21 of the total cases (ITP). When comparing hyper destructive thrombocytopenia (MPV 11.51 1.97) to hypo productive thrombocytopenia (MPV 8.34 2.), the former had a much higher value. Similarly, the PDW was higher in the former group (16.67 1.03) compared to the latter group (14.68 2.29) (mean SD).

Conclusion: Preliminary information on the type of thrombocytopenia, whether it is hyperdestructive or hypoproductive, can be gleaned from platelet indices. This will help direct patient management decisions and may eliminate the necessity for bone marrow testing for some individuals. In addition, there is no extra charge or requirement for a second blood sample to determine platelet indices.

Keywords: Underproductive platelet indices, hyperdestructive, thrombocytopenia, bone marrow

Introduction

The term "thrombocytopenia" refers to a platelet count of fewer than 150000/microliter, which can be caused by a variety of haematological and pathological conditions [1]. There are four probable causes: hypoproductive thrombocytopenia, hyperdestructive thrombocytopenia, aberrant platelet distribution, and dilutional loss. It is possible to learn the cause behind thrombocytopenia by monitoring platelet indicators other than the simple platelet count [2, 3]. These platelet indicators include the mean platelet volume, platelet distribution width, and plateletcrit.

The mean platelet volume (MPV) assesses the normal size of platelets seen in the blood and can be used to determine whether or not the bone marrow is manufacturing platelets adequately. It is a measurement of platelet anisocytosis and represents the degree to which platelets differ from one another [4, 5].

It is computed by multiplying the platelet count by the mean platelet volume and can be considered of as a measure of the total number of platelets circulating in a given amount of blood, like the haematocrit. There are four major forms of thrombocytopenia, each characterized by a distinct set of underlying diseases. Disturbances in platelet synthesis (known as hypo-productive), platelet destruction (known as hyperdestructive), platelet distribution, and dilutional loss (known as hypo-dilute) are all included in this group [6-8]. Specific megakaryocyte suppression, as seen in congenital thrombopoietin receptor mutation, May-Hegglin syndrome, Wiscott-Aldrich syndrome, drugs, chemicals, and viral infections; and systemic bone marrow failures, as seen in haematological malignancies, are both potential causes of hypoproductive thrombocytopenia. It's possible for hypoproductive thrombocytopenia to result from either of these two forms of megakaryocyte suppression. The most prevalent causes of hyper-destructive thrombocytopenia are immunological processes, such as idiopathic or primary autoimmune illness, secondary infections (viral or parasite), drug-induced hyper-destructive thrombocytopenia, post-transfusion purpura, and disseminated intravascular hemolysis [9]. A massive blood transfusion can produce a disorder known as dilutional thrombocytopenia, which results in an irregular distribution of

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platelets throughout the body. When platelets are stimulated, they enlarge and undergo morphological changes that result in a rise in both the MPV and the PDW. The platelet count and platelet indices are calculated with the help of an automated electronic Coulter machine. The goal of this study is to evaluate whether or not platelet indices may be used to arrive at a preliminary diagnosis of thrombocytopenia and whether or not they are beneficial in the evaluation of thrombocytopenia [10-12].
Our research aims to determine the utility of platelet indices in the diagnosis of thrombocytopenia, the relationship between platelet indices and bone marrow abnormalities, and the relationship between platelet count and platelet indices in the evaluation of thrombocytopenia. That's the sort of stuff we were hoping to accomplish.

Methodology
From June 2021 to May 2022, a prospective observational and case control study was done by researchers in the haematology section of the Department of Pathology, Maheswara Medical College and Hospital, Sangareddy, India.
There were no moral problems with the research. Each person who participated in the study provided written informed permission. In the current study, individuals with thrombocytopenia were analyzed for their age-related etiology and platelet volume characteristics gathered with automated blood cell counter for their clinical significance. In the case of the controls, the healthy patients who came in for their annual physical served as examples of the norm.

Inclusion criteria: All patients with low platelet and white blood cell counts

Exclusion criteria
- Patients with pseudo thrombocytopenia
- People who had just received a platelet transfusion within the previous 10 days
- Those who suffer from coagulation disorders

Results
50 people were used in the study. Patients with thrombocytopenia, defined as a platelet count of fewer than 1,500,000, were analyzed in this study to determine the cause of their condition and its progression with age, and platelet parameters were gathered using an automatic blood cell counter. In order to tell the difference between hyperdestructive and hypoproductive thrombocytopenia, this study aimed to see if platelet measures could help.

Table 1: Distribution by Age in hyper destructive and hypo destructive case groups

Sr. No.	Age (Years)	No. of Cases
1.	11 to 20	10
2.	21 to 30	8
3.	31 to 40	15
4.	41 to 50	10
5.	51 to 60	5
	61 to 70	2
	Total	50

The age bracket of people that make up the majority of the adult population ranges from 11 to 70 years old. According to the data presented in the table above, the age range of 31–40 years old has the highest number of instances, followed by the age range of 41–50 years old.

Mean Age in the Groups
In the group of people who had hyperdestructive thrombocytopenia, the mean age was 45.33 years old, and the standard deviation was 13.92 years. In the group of people who had hypoproductive thrombocytopenia, the mean age was 40.51 years old, and the standard deviation was 14.91 years. All of the patients had an average age of 42.2 years, with a standard deviation of 14.63 years.

Table 2: Aetiology wise distribution of patients in hypo productive thrombocytopenia

Sr. No.	Diagnosis	No of Patients
1.	Megaloblastic anaemia	21
2.	Post chemotherapy	9
3.	Lymphoma	5
4.	CML	3
5.	Acute leukemia	2
	Total	40

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The distribution of cases according to their genesis in hyperdestructive. The cause of the forty instances (one hundred percent) was determined to be immune-mediated thrombocytopenia.

Table 3: MPV in hyperdestructive and hypoproductive thrombocytopenia

Cause		TP	FP	TN	FN	Sensitivity	Specificity
Hyper-Destructive	MPV	15	05	17	04	86.1%	82.7%
	PDW	5	16	22	0	99.8%	59.1%
	Pct	2	21	1	22	5.1%	8.9%
Hypo-Productive	MPV	12	27	38	0	100%	57.3%
	PDW	32	05	37	2	98.1%	85.9%
	Pct	5	36	0	39	12.4%	0.01%

When comparing the platelet parameters (MPV, PDW, and Pct) in the two groups of thrombocytopenia (cases and controls), it was shown that hypo destructive thrombocytopenia had lower mean values for MPV, PDW, and Pct than the other kind of thrombocytopenia.

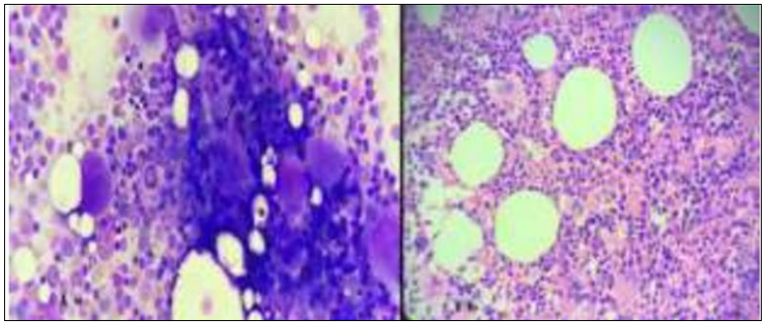

Fig 1: Megakaryocyte Hyperplasia

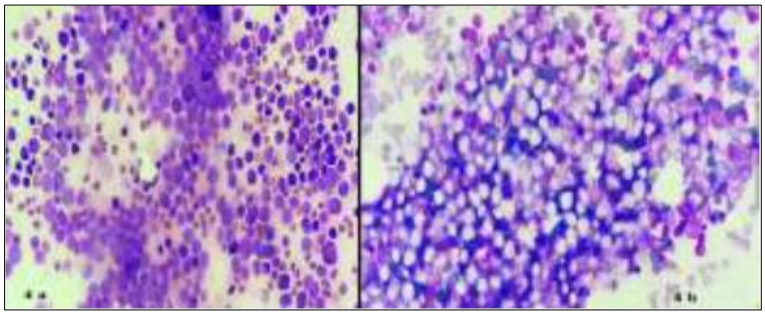

Fig 2: Bone Marrow Aspiration in a Case of AML Showing Blasts

The authors of this study compared patients with and without hyperdestructive and hypoproductive thrombocytopenia to establish the diagnostic sensitivity and specificity of their methods. Before calculating sensitivity and specificity, it was necessary to categorize patients as true positives, true negatives, false positives, and false negatives. Platelet counts, mean platelet volume, and platelet distribution width all showed statistically significant differences between the two groups (p 0.00017, p 0.00001, and p 0.00002, respectively). The percentage was 0.01755, which is not significant.

Discussion

Platelets are derived from megakaryocytes in the bone marrow and are extremely complicated anucleate cells. Upon proper activation, platelets have developed into remarkable cells with the ability to contract and release physiologically active substances.

The quantity, size, distribution, and structure of platelets can be learned a great deal from a properly constructed peripheral blood film. Misdiagnosis may occur if an artifact is present. Because of the consistency of the information they provide, automated cell counters are becoming increasingly popular in both developed and developing nations. In this study, we compared the results of bone marrow examinations with those of the automated blood cell counter to determine the etiology of thrombocytopenia [13], evaluating the utility of platelet parameters obtained by the former in the differential diagnosis of hyperdestructive and hypoproductive thrombocytopenia. Both the 11-year-old and the 70-year-old patients were adults. Thirty percent of patients fall between the ages of 41 and 50, where 18 cases were found. Afterwards, the next largest age group, those between 31 and 40 years old, accounting for 23.3% of the total cases with 14. Average ages for participants with hyperdestructive thrombocytopenia were 45.33 13.92 and 40.51 14.91 years, respectively, in the current study [14]. Patients

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with hyperdestructive thrombocytopenia had a mean age of 49.1 years, while those with hypoproductive thrombocytopenia had a mean age of 72 years, three decades later. The male-to-female ratio in our research of people with hyperdestructive thrombocytopenia was 2.5:1, significantly higher than the ratio of 1.5:1 seen in investigations by Rajalakshmi *et al*, [15]. For hypoproductive thrombocytopenia, the male-to-female ratio was 1.20:1. The platelet count is often below 80,000 per microliter (microL) in patients with hyperdestructive thrombocytopenia, with the median value hovering around 60,000 microL. A statistically significant difference (p 0.0001) was found between the mean platelet count of the hyperdestructive age group and that of the Controls, where the numbers were, respectively, 43.5 20.9 and 228 103 55.2. To put it another way, hyperdestructive thrombocytopenia is far more severe than the standard variety. The hyperdestructive group displayed more thrombocytopenia (16) than the hypoproductive group. All of the cases in the hyperdestructive group were found to be due to immune thrombocytopenic purpura, according to the current investigation. Results of this nature were also reported by Khaleed *et al*. and Numbenjapon *et al*., cited by Baig *et al*. (100 and 52 percent, respectively). If you're trying to figure out what's causing your blood counts to drop, a bone marrow biopsy could be a great place to start. It's an invasive and unpleasant procedure, though. Therefore, it may be beneficial to first examine platelet indices in order to narrow down the potential reasons of thrombocytopenia, rather than leaping straight to the bone marrow treatment. It is critical to determine if thrombocytopenia is due to an abnormally high rate of platelet destruction or a lack of platelet production [17-19]. The hypoproductive form of thrombocytopenia was more common than the hyperdestructive form among the 60 cases of thrombocytopenia that were analyzed. Several employees made parallel observations. Studies have shown that platelet indices like mean platelet volume, platelet distribution width, and platelet count can be used as markers for the early diagnosis and categorization of thrombocytopenia to evaluate bone marrow activity in platelet disorders, and this has sparked further research into platelet indices. In most cases, a diagnosis of ITP is made after all other potential explanations for thrombocytopenia have been ruled out. A decrease in platelets was observed in the peripheral blood smear, whereas RBC and WBC counts were normal. The number of megakaryocytes in the bone marrow aspirate has grown, but the number of platelets has decreased significantly. Small, hypolobated megakaryocytes are abundant in the marrow of long bones. There is evidence that vacuolations can form in megakaryocytes. Almost of the cases with ITP indicated young, immature, more spherical, less polypoid megakaryocytes and very few mature platelet-producing megakaryocytes on morphology in the present study [20, 21].

It is possible that the age of the haematological analyzer used in the studies accounts for the discrepancies in MPV threshold values between studies; older automated analyzers, which might have been used in the studies in question, are unable to distinguish platelets from other similarly sized particles like fragmented red or white blood cells, cell debris, and immune complexes. In addition, since platelets and RBCs cannot be isolated, only normal-sized platelets are counted. Moreover, a number of papers have shown that MPV depends on a range of factors, such as how long it has been since venipuncture, the type of anticoagulant used, the temperature at which the specimen was stored, and the detection method [22, 23]. A genuine, underlying variation in platelet indices across populations is a further possibility. Hong *et al*., used the Sysmex XT 2100 to analyze platelet indices in healthy Chinese people from a variety of regions, finding regional differences. The MPV was between 10.30 and 12.36, with an average of 12.34 [24].

There is no correlation between the severity of hypoproductive or hyperdestructive thrombocytopenia and the platelet crit value, which is a reflection of the percentage of platelets in a certain volume. The hyperdestructive group's mean Pct in our study was 0.05 0.04. The mean Pct in hypoproductive group which was 0.11±0.12. A statistically insignificant P value was found to be 0.017. It was unable to discriminate between hyperdestructive and hypoproductive thrombocytopenia because the majority of our patients were within the normal range. The results found by Khanna *et al*. and Kaito *et al*. 11 were very similar. Patients with ITP had a considerably higher P-LCR index compared to the control group, while patients with myeloid insufficiency had a significantly lower value compared to the control group. Our findings showed that PCT was not useful as a diagnostic tool for determining the cause of thrombocytopenia.

Conclusion

Hypoproductive thrombocytopenia is not characterized by such an increase and does not typically result in severe thrombocytopenia, whereas hyperdestructive thrombocytopenia is associated with an increase in platelet indices like MPV and PDW and is typically accompanied by extremely low platelet counts. Neither of the thrombocytopenias shows any signs of improvement in the plateletcrit. Even before bone marrow results are in, platelet indices might provide important preliminary information on the type of thrombocytopenia. Since they can be done while counting blood cells, there's no need for an extra blood sample or extra time or money to do them.

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References

1. Vinholt PJ, Hvas AM, Nybo M. An overview of platelet indices and methods for evaluating platelet function in thrombocytopenic patients. European journal of haematology. 2014 May;92(5):367-76.
2. Beyan C, Kaptan K, Ifran A. Platelet count, mean platelet volume, platelet distribution width, and plateletcrit do not correlate with optical platelet aggegation responses in healthy volunteers. Journal of thrombosis and thrombolysis. 2006 Dec;22(3):161-4.
3. Basin TS, Sharma S, Manjari M, *et al*. Changes in megakaryocytes in cases of thrombocytopenia: bone marrow aspiration and biopsy analysis. J Clin Diagn Res 2013;7(3):473-479.
4. Khatri S, Sabeena S, Arunkumar G, Mathew M. Utility of platelet parameters in serologically proven dengue cases with thrombocytopenia. Indian Journal of Hematology and Blood Transfusion. 2018 Oct;34(4):703-6.
5. Elsewefy DA, Farweez BA, Ibrahim RR. Platelet indices: consideration in thrombocytopenia. Egypt J Haematol 2014;39(3):134-138.
6. Budak YU, Polat M, Huysal K. The use of platelet indices, plateletcrit, mean platelet volume and platelet distribution width in emergency non-traumatic abdominal surgery: a systematic review. Biochem Med (Zagreb) 2016;26(2):178-193.
7. Khaleed JK, Ahmed AA, Abeer AM. Platelet indices and their relations to platelet count in hypo-productive and hyper-destructive thrombocytopenia. Karbala J Med. 2014;7(2):1952-1958.
8. Jandl JH. Blood: Pathophysiology. Boston: Blackwell Scientific Publications; c1991. p. 220-227.
9. Rajalakshmi RB, Mahadevappa A, Patel S. Evaluation of thrombocytopenia in megaloblastic anaemia by platelet indices and megakaryocytes comparison with hypoproduction and hyperdestruction. National Journal of Laboratory Medicine 2017;6(1):18-22.
10. Numbenjapon T, Mahapo N, Pornvipavee R, *et al*. A prospective evaluation of normal mean platelet volume in discriminating hyperdestructive thrombocytopenia from hypoprodcutive thrombocytopenia. Int. J Lab Hematol. 2008;30(5):408-414.
11. Baig MA. Platelet indices evaluation of their diagnostic role in pediatric thrombocytopenia (one-year study): International journal of Research in Medical Sciences. 2013;3(9):2284-2289.
12. Islam S, Islam SM, Ahmed UM, *et al*. Role of mean platelet volume (MPV), platelet distribution width (PDW) and platelet large cell ratio (P-LCR) value in the diagnosis of immune thrombocytopenic purpura. Hematology and Transfusion International Journal. 2016;2(2):1-5.
13. Kaito K, Otsubo H, Usui N, *et al*. Platelet size deviation width and mean platelet volume have sufficient sensitivity and specificity in the diagnosis of diagnosis of immune thrombocytopenia. British Journal of Haematology. 2005;128(5):698-702.
14. Ntaios G, Papadopoulos A, Chatzinikolaou A, *et al*. Increased values of MPV and PDW may provide a safe positive diagnosis of ITP. Acta Harmalol. 2008;119(3):173-177.
15. Llewellyn EA, Todd JM, Sharkey LC, Rendahl A. A pilot study evaluating the prognostic utility of platelet indices in dogs with septic peritonitis. Journal of Veterinary Emergency and Critical Care. 2017 Sep;27(5):569-78.
16. Shah AR, Chaudhari SN, Shah MH. Role of platelet parameters in diagnosing various clinical conditions. National Journal of Medical Research. 2013;3(2):163-165.
17. Khairkar SP, More S, Pandey A, *et al*. Role of mean platelet volume (MPV) in diagnosing categories of thrombocytopenia. Indian Journal of Pathology and Oncology. 2016;3(4):606-610.
18. Nelson RB 3rd, Kehl D. electronically determined platelet indices in thrombocytopenic patients. Cancer. 1981;48(4):954-956.
19. Katti T, Mhetre S, Annigeri C. How far are the platelet indices mirror image of mechanism of thrombocytopenia mystery remains? Int. J Adv. Med. 2014;1(3):200-220.
20. Vidyadhar S. Diagnostic implication and utility of platelet indices in differentiating hypoproductive and hyperdestructive thrombocytopenia. J Dent. Med. Sci. 2019;18(8):7-11.
21. Negash M, Tsegaye A, Medhin AG. Diagnostic predictive value of platelet indices for discriminating hypo productive versus immune thrombocytopenia purpura in patients attending a tertiary care teaching hospital in Addis Ababa, Ethiopia. BMC Hematol. 2016;16:18.
22. Oncel M, Kiyici A, Oncel M, Sunam GS, Sahin E, Adam B. Evaluation of platelet indices in lung cancer patients. Asian Pacific Journal of Cancer Prevention. 2015;16(17):7599-602.
23. Parveen S, Vimal M. Role of platelet indices in differentiating hypo-productive and hyper-productive thrombocytopenia. Annals of Pathology and Laboratory Medicine. 2017;4(3):A289-A291.
24. Jeon K, Kim M, Lee J, Lee JS, Kim HS, Kang HJ, *et al*. Immature platelet fraction: a useful marker for identifying the cause of thrombocytopenia and predicting platelet recovery. Medicine. 2020 Feb;99(7).